BNFL Inc.

Section 2.9

Fire Protection

Contents

Section 2.9
Fire Protection

2.9.1. Fire Protection System

The facility Fire Protection System is comprised of an integrated complex of components and equipment for early detection and rapid suppression of fires. The system is supported by the facility electrical power supply system and building ventilation systems for smoke control and exhaust. Additional support systems are addressed in Section 2.9.1.5, "Support Systems."

The Fire Protection System includes a fire detection and alarms system, a fire water supply system, and water-based and gaseous fire suppression systems.

2.9.1.1. Fire Detection and Alarms System

The fire detection and alarms system is designed to provide early detection and notification of a fire at its incipient stage and its location. The notification alarms include indication of the fire location to facilitate an immediate fire response to the fire-affected area. With numerous buildings, the system is a network of building fire alarm systems with a Master Fire Alarm Control Panel located at the main control room. Each building fire alarm system has its own Building Fire Alarm Control Panel, which receives detector or water flow signals from the respective building area and in-duct fire/smoke detectors. Upon water flow, detection of fire/smoke, or activation of a fire alarm this building fire alarm control panel annunciates the fire condition locally at the fire-affected area by horns and strobes, concurrent with the transmission of the fire signal to the Master Fire Alarm Control Panel and other designated locations as necessary. The Fire Alarm Control Panel also provides output signals to the interfacing systems, such as the ventilation systems. The ventilation system of the fire-affected area is controlled to stop operating when a fire is detected and all communicating ducts isolated, in order to minimize the spread of the fire effects and to allow a discharge and flooding of the fire-affected space with the gaseous suppressant where such systems are provided.

The fire detection and alarms system is designed to be electrically supervised. The system is designed to be continuously energized, and has adequate battery backup in case of a loss of power. A fault within the system is also detected automatically and annunciated at the designated location(s), complete with the nature of its fault to facilitate immediate corrective actions.

The secondary function of this system is to provide status supervision of the facility fire protection systems; i.e., the fire water supply system and the suppression systems. The status of the fire protection system components requiring supervision, such as, the positions of shut-off valves, isolation valves, level of fire water in the tank, readiness of the suppression systems, are also monitored by this Fire Detection and Alarm Systems. Any off-normal status of the fire water and fire suppression systems is annunciated for immediate disposition or corrective actions that assure continuous protection of the facility.

An overview of the fire detection system is shown in Figure 2.9-1.

2.9.1.2. Fire Water Supply System

The fire water supply system assures supply of fire suppression water at a flow rate and pressure sufficient to satisfy the demand of any automatic sprinkler system plus expected demand for fire hoses, for a minimum of the expected duration of the worst-case fire. The system has two 100% capacity reliable water sources along with fire pumps. The fire pumps are one electric motor-driven fire pump and one diesel engine driven in order to maintain 100 percent of fire pump design capacity, assuming failure of the largest fire pump or the loss of power. The fire pumps are physically segregated so that both fire pumps are not subject to a common cause failure, such as a fire in the fire pump house.

The fire water distribution is looped and hydraulically designed to meet the expected fire suppression systems demand - in flows and pressures, assuming that a single failure occurs at the shortest leg between the fire pumps and the supply connection to the fire suppression system. The fire water main loop is sectionalized with sectionalizing Post Indicating Valves to allow isolation of a single break point at the yard main while maintaining availability of firewater to the fire suppression systems.

Within the facility, hydrants are provided at strategic locations to facilitate manual fire fighting of fires from a safe distance.

An overview of the fire water supply system is shown in Figure 2.9-2.

2.9.1.3. Fire Suppression System

The fire suppression system includes an automatic water sprinkler system. The need for automatic water sprinkler system in any fire area is determined by the results of the Fire Hazards Analysis. The system has an electrically supervised shutoff valves, zoned alarm check valves, distribution piping and sprinkler heads with fusible elements. Upon sensing of a fire that causes operation of the fusible element, the sprinkler discharges water providing a water spray over the fire-affected area at a density as specified. As soon as one of the sprinkler heads breaks open and discharges water, the water flowing through the system is annunciated at the designated fire alarm control panel(s). The designs of the fire suppression system, including the sprinkler system, employed within the facility vary depending upon the design recommendation of the responsible fire protection engineers and the system selection basis commensurate with the Fire Hazards Analyses.

Alternate fire suppression systems are employed within the facility. For example, in lieu of a water based suppression system, where it is more appropriate for the specific hazard, a foam-water spray system, a chemical suppression system, or a gaseous extinguishing system is employed. A foam-water spray system is similar to a water sprinkler except that the suppressant is a foam water solution, utilizing 3 to 6% of Aqueous Film Forming Foam (AFFF). Chemical or gaseous system are designed to have a local storage or source of suppressant, and a fire detection system that will automatically discharge the fire suppressant into the fire-affected area upon detection of a fire.

Standpipe and hose stations along with portable extinguishers are provided to facilitate manual fire fighting. Each hose station has a 1-½ in. and a 2-½ in. hose connections. Emergency lighting and communication systems are also provided to facilitate fire-fighting activities.

2.9.1.4. Smoke Control and Removal

Smoke and heat venting from the fire-affected area is accomplished by the operation of either the area ventilation or dedicated smoke removal system. The venting flow paths are designed such that it minimizes the spread of smoke and heat and allows monitored and controlled release of potentially contaminated effluent streams into the atmosphere.

2.9.1.5. Support Systems

The fire protection system interfaces with the following support systems:

1) Integrated control system (ICS) - provides the distributed control and instrumentation data communications network to support the monitoring and control of facility systems and, interfaces with the fire protection system main and local control panels

2) Raw water system - provides an alternate water source to the fire protection system and can refill the fire water storage tanks

3) Facility air system - provides air for maintenance of the fire pumps

4) Instrument air system - provides air for operation of control valves and for pressure maintenance of the pre-action or dry pipe systems

5) Fuel oil system - provides fuel oil for the diesel engine-driven fire pump

6) Waste water system - provides a drainage and disposal path for firewater discharged when the fire protection system or equipment is tested and from fire suppression activities

7) Electrical system - provides power for the fire pump and jockey pump motors, valves, panels, and instrumentation. Battery-backed power for the fire detection and alarm system is included within the fire detection and alarm panel.

Failures of the above-listed support systems that could have adverse impact on the fire detection and suppression are addressed in the table below. Note that the fire detection and alarm system operates independent of the ICS. Failure of the ICS does not adversely impact the fire detection and alarm system. In addition, failure of the raw water system or the instrument air system do not challenge the fire suppression system as they are provided to support maintenance activities. For this reason, neither the ICS, raw water system, or the instrument air system need to be designated as ITS for the purpose of supporting the fire protection system.

2.9.2. Facility Buildings

The facility buildings important to safety are constructed of noncombustible and limited combustible materials to the extent practical. These materials are primarily reinforced concrete, gypsum, masonry block, and structural steel. Fireproofing of structural steel is provided where needed to maintain fire rated assembly criteria. The effects of heat generated by a fire are considered in the design, and if appropriate a Fire Hazard Analysis, is conducted to confirm the need for fire proofing of structural steel.

Localized structural steel fireproofing is provided to preclude adverse structural impact due to the fire effects on the structural members. At locations where structural failures could adversely affect the capabilities to achieve a safe state, the structural steel members are fireproofed as appropriate. Noncombustible and limited combustible materials furnishings are used to the extent practical to further reduce contribution to area fire loads. Interior finish materials are selected to meet limited flame-spread, fuel-contributed, and smoke-developed criteria. This meets the intent of limiting fire spread.

The plant buildings important to safety are subdivided into fire areas to isolate potential fires and minimize the risk of the spread of fire and the resultant consequential damage from corrosive gases, fire suppression agents, smoke, and radioactive contamination. Fire barriers are provided to separate fire areas from adjacent fire areas. Three-hour fire barriers are non-combustible and surround fire areas containing equipment important to safe state of the plant. The resistance rating of fire barriers in other areas of the plant may be less than 3 hours, where justified by the Fire Hazard Analyses, but not less than 2 hours.

Three-hour fire barriers provide complete separation of redundant equipment important to safe state of the plant, except where the need for physical separation conflicts with other overriding requirements.

Openings and penetrations through fire barriers are protected to maintain integrity and fire-resistance rating of the barrier. Openings include doorways and duct penetrations of fire rated assemblies. Doorways are protected using approved fire doors and frames of an appropriate fire rating. Duct penetrations are provided approved fire dampers installed in the plane of the wall or floor.

Penetrations are protected using recognized and approved methods, systems or products, installed per the manufacturer’s instructions. Examples of penetrations include cable, conduit, and pipe passageways through fire rated assemblies, and cable trays which penetrate such assemblies.

Provisions to limit contamination are incorporated in the building design. The design incorporates the following:

- Limits on areas and equipment subject to contamination due to fire
- Selection of materials which minimize the contribution to contaminating the air when exposed to fire or heat
- Design of facilities, equipment and utilities to facilitate decontamination.

Building life safety features include life safety escape routes, and fire-fighting personnel access routes that are provided for each fire area. Fire exit routes are clearly marked. Emergency lighting is provided

to meet minimum lighting needs along escape paths, access routes to areas containing equipment necessary for the safe state of the plant and to enable fire-fighting efforts to occur.

Each plant building generally has a minimum of two enclosed stairways for emergency access. Means of egress, corridors, and interior safe refuge areas are protected by fire-resistance enclosures and automatic sprinkler systems. Stairwells, and elevator shafts, that penetrate fire barrier floors, are enclosed in construction having a fire resistance rating of at least 2 hours. Openings are protected with approved automatic or self-closing doors having a rating of 1.5 hours.

The main control room is designed to permit rapid location of fires in the under floor and ceiling spaces, as provided, and allow ready access for manual fire fighting. For example, control rooms frequently have raised floors with two foot square removable floor panels. Suction cups with handles are located to enable operators to remove the panels to access the under floor for investigation and fire fighting purposes.

Process tanks incorporate purging or active venting to minimize the possibility of flammable mixtures within the tanks. Other passive design features include arrangement of drainage in areas where the release of flammable or combustible liquids may occur so that the release is taken to a safe location, along a route to minimize exposure to critical equipment, power supplies or instrumentation cables. As a design alternative, drainage are curbed or diked for later removal.

An overview of fire protection systems is shown in Figure 2.9-3.

2.9.3. Hazardous Situations

Fire hazards include the existence of combustible and explosive materials and high-energy sources where they cannot be eliminated from the design or operation of the facility. Examples are HEPA filters (combustible material) and the Melter Caves (high-energy source). Hazardous situations that accompany these hazards include burning and explosions.

Hazards that are part of the fire protection system include the fire suppression agents. The associated hazardous situations are having these agents contact equipment not associated with a fire and the potential for the agents to spread radioactive and hazardous materials.

The following table identifies faults associated with these hazardous situations.

Figure 2.9-1. Fire Detection and Alarms.

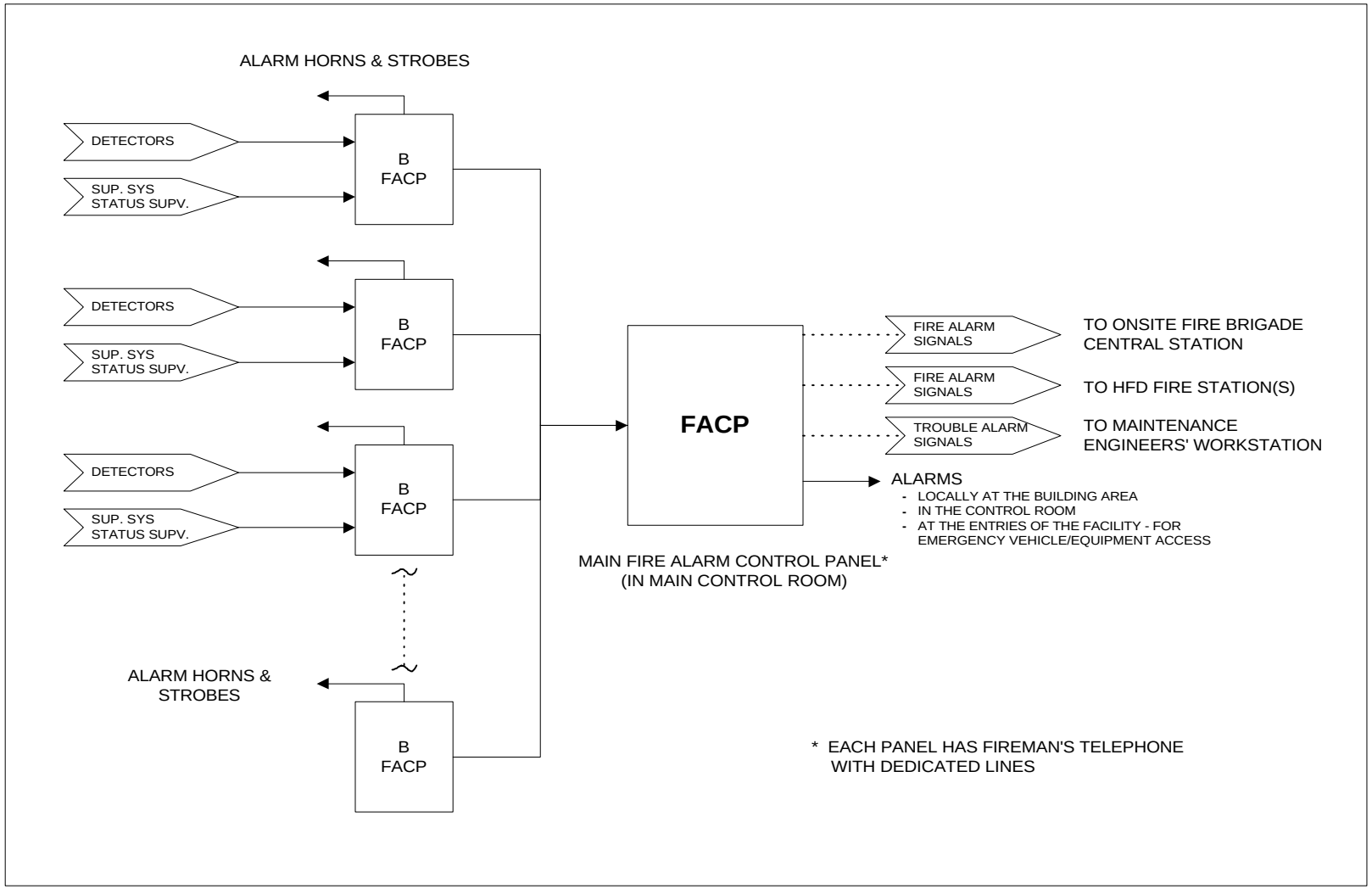

Figure 2.9-2. Fire Water Supply System.

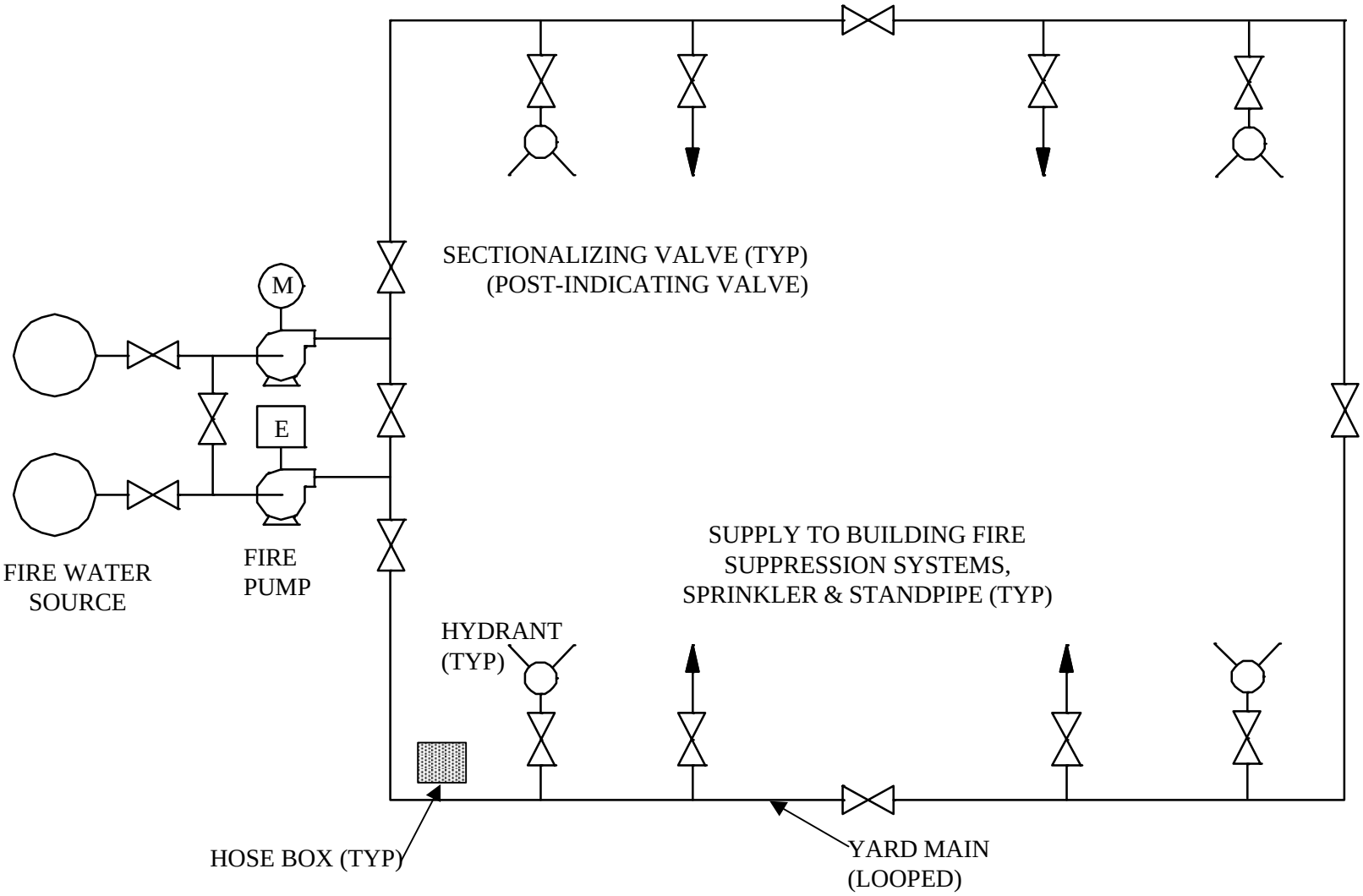

Figure 2.9-3. Building Fire Protection Features.

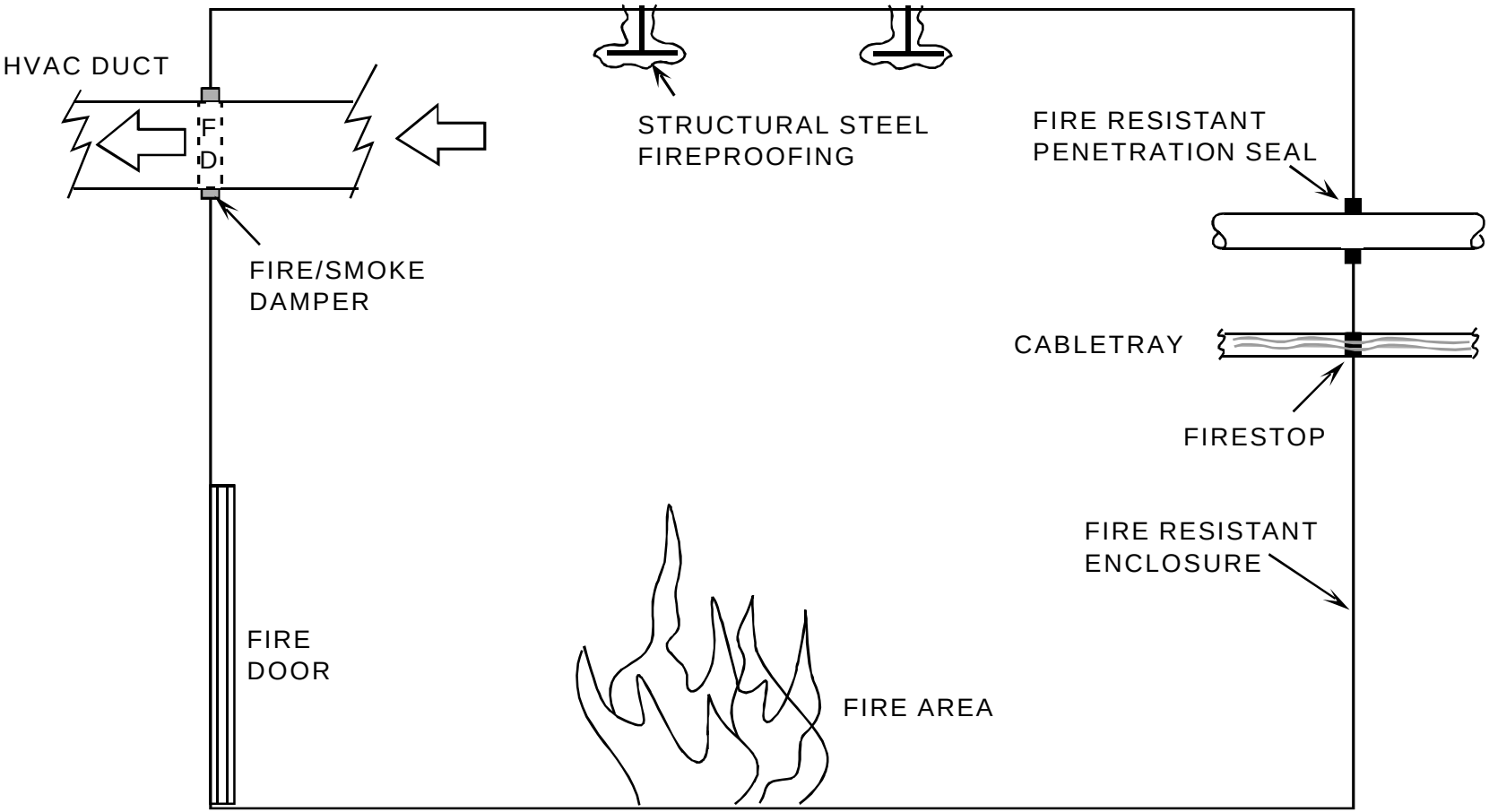

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
Internal Fire (External fires are included in Section 2.10)	Building Structure	Limit quantity of combustible fire load and spread of fire	Materials used have low fire and smoke spread ratings to extent possible. Use of materials defined by: DOE STD 1066-97; UBC; NFPA 801; NFPA 220; IEEE 383 and limits on flame spread, fuel contributed and smoke developed of materials used serve to ensure that non-combustible and limited combustible materials are used to the extent possible in the design and construction of the facility. Non-combustible and limited combustible materials are passive features of the facility design. The pre-startup facility walk down confirms implementation of these standards. Configuration management of the design and periodic plant walk downs during facility operation ensure that implementation of the standards is maintained. The specification of these materials represents fire prevention through conservative design of the facility structure

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
	Structural steel	Prevent warping or distortion of building structure and load bearing capability under fire conditions. This will prevent release of contained materials that could provide additional fuel, create hazardous conditions or complicate fire-fighting efforts	The structural steel maintains its strength during design basis fires. The safety function of the fire proofing is assured by meeting the fire proofing requirements defined in DOE STD 1066-97 and DOE O 420.1. The effectiveness of the fire proofing material is further assured by specifying the material to ASTM E 119. Fire proofing materials are passive features of the facility design. Pre-startup plant walk down confirms adequate fire proofing of steel has been provided. Configuration management of the design and periodic walk down during facility operation ensure that fire proofing has not been removed such that the steel is no longer adequately protected

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
			Limit the severity of the fires and limit the fire to one fire area. Storage, handling and operations involving combustible liquids and gases are compliant with NFPA 30. Similarly, gas system design to incorporate design features to accomplish these goals are found in NFPA 55, and NFPA 59; DOE STD 1066-97; DOE O 420.1. Maintenance of these design features is assured by the configuration management program. Routine facility walk downs (e.g., to identify transient combustibles) assure that the implementation of the standards is maintained
	Vessel ventilation system and passive venting of defined vessels. (See Section 2.2.2, Vessel Vent System.)	Limit process generated hydrogen to less than lower flammability limits	By venting, purging, or inerting the hydrogen concentration is maintained below the lower flammability limit. Vapor lean mixtures within tanks is achieved by following design criteria in NFPA 69. Air purging or venting can be interrupted if a passive vent is provided but the lower flammability must not be challenged

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
			The prevention or arresting of ignition sources prevents the ignition of combustible gases. This is achieved by using principles provided in NFPA 497, NFPA 30, NFPA 780; NFPA 801; and DOE STD 1066-97with input from operations and design engineers. Once electrical area classification is established, the electrical design will ensure that any fixed electrical equipment is constructed and installed to meet the requirements found in NFPA 70 and DOE O 420.1
	Fire/smoke dampers	Prevent smoke, hot gases, or gaseous fire suppressants from spreading to other areas. Installation of approved fire or smoke dampers is necessary to prevent the passage of fire or smoke through fire rated wall and ceiling assemblies where penetrated by HVAC ducts	The effectiveness of fire/smoke dampers is assured by their design and installation to isolate the design basis fires to the affected fire area. Design and installation of the fire/smoke dampers to the UBC; DOE STD 1066-97; DOE O 420.1; NFPA 90A and NFPA 92A provide assurance that the fire/smoke dampers will provide the required isolation. Periodic inspection will confirm the fire/smoke dampers remain functional.

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
	Automatic suppression in areas with fire loading • wet pipes • dry pipes • deluge and pre-action • sprinkler systems • water mist systems • foam water systems • gaseous suppression systems	Extinguish or control fire	The effectiveness of the automatic suppression system is by its design to extinguish or control the fire and limit damage to the affected fire area (with credit given for fire barriers). The design, installation, and pre-startup of the wet, pipe, dry pipe, deluge, and pre-action sprinkler systems, water mist systems, foam-water systems or gaseous suppression systems to NFPA 12; NFPA 13; NFPA 15; NFPA 16; NFPA 750; NFPA 2001; as well as in the UBC provide assurance the automatic suppression system will function as required. Periodic inspection and testing will confirm the system remains functional. Defense in depth is achieved by inclusion of the fire detection and alarm system that would summon the fire brigade. The fire brigade could use portable extinguishers and/or the hose stations to suppress the fire. The automatic suppression system is employed to provide for rapid suppression of a fire. However, the safety analysis will demonstrate there will be no impact on safety should the fire not be extinguished.

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
	Fire detection and alarm	Identify fire signatures and annunciate alarm for fire brigade response for initial fire fighting/facilitate evacuation of personnel	The effectiveness of the design of the fire detection and alarm system is assured by its design to provide for early detection of a fire to facilitate prompt response to the fire brigade and allow of evacuation of non-essential personnel. The design and installation criteria for fire detection and alarm systems found in NFPA 72 provide assurance the system will detect fires and alarm as required; including provisions for reliability and redundancies. Periodic testing of the system will confirm the fire detection and alarm system remains functional. The fire detection system is employed to provide for rapid suppression of the fire. However, the safety analysis will demonstrate there will be no impact on safety should the fire not be detected. The fire detection and alarm system includes, within the panel, an uninterruptible (battery-backed) power supply. This supply will power the system for 24 hours without external power

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
	Detection and suppression system in control room ceiling interstitial space and under false floor, and in cable spreading rooms	To provide for early detection and suppression for fire involving control room power or instrumentation wiring. Protection for computer and control room cable areas, and power cables present a fire protection problem due to the potential for release of toxic products of combustion which can create hazardous conditions, allow for spread of fire or complicate fire fighting. In addition, certain released chemicals can damage electronic components to acid etching or other damage	The effectiveness of the design and installation of the control room detection and suppression systems is assured by their ability to provide for prompt suppression or control of fires while not putting critical equipment not involved with the fire at risk and not putting the control operators at risk do to release of toxic chemicals. Compliance to NFPA 13, NFPA 2001; NFPA 72 and start-up and periodic inspection provide assurance the system will provide this required detection and suppression Defense in depth is achieved by inclusion of portable extinguishers in the control room

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
	Emergency Lighting	Facilitate fire fighting and evacuation of personnel and safe state operator actions	The effectiveness of the emergency lighting system is assured by compliance to the design criteria for minimum lighting levels for employee evacuation or fire fighting efforts, and emergency power requirements to maintain such lighting levels under emergency conditions causing loss of facility power in total or in part as found in the UBC; NFPA 101; NFPA 801; DOE STD 1066-97; DOE O 420.1. Periodic testing of the emergency lighting system (e.g., batteries) provides assurance the effectiveness of the system is maintained. Defense in depth is achieved by availability and use of portable lanterns. The electric power for the emergency lighting is uninterruptible and must power emergency lighting for 2 hours

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
	Stairways and egress routes	Facilitate fire fighting and evacuation of personnel and safe state operator actions	The effectiveness of life safety provisions under emergency conditions is provided by incorporating the egress and exiting design criteria found in the Life Safety Code, NFPA 101. This will typically result in stairways provided, egress routes marked, and egress routes protected by fire-resistance enclosures and automatic suppression. NFPA 101. Maintaining the effectiveness of the life safety and emergency response provisions is assured by periodic plant walk downs (e.g., confirm passageways are not blocked, signs are in place).
	Hose stations	Provide for manual fire fighting. Manual fire fighting efforts may supplement automatic suppression systems, or enable fires to be controlled before automatic systems activate	The effectiveness of the hose stations is provided by their locations such that areas containing combustible materials can be reached with the length of hose provided. The design and location of one of these manual features, hose stations, is contained in DOE STD 1066-97; DOE O 420.1; NFPA 801. Periodic inspections of the hose stations confirm they remain functional. The hose stations are provided to support manual fire suppression. However, the safety analysis will demonstrate there will be no impact on safety should the fire not be extinguished

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
	Alarm to Fire Department and plant-to-offsite communication	Provide for mutual aid to facilitate extended manual fire suppression by the fire department; obtain other assistance as required.	The effectiveness of the offsite fire notification system is provided by the Fire Alarm Code, NFPA 72. This code provides for proper notification of the local fire department as well as the facility fire brigade. Additional design considerations for proper alarm are found in NFPA 801; DOE STD 1066-97; DOE O 420.1. Testing of the link to off-site agencies will confirm the system remains functional
	Fire barriers; penetration seals; fire rated assemblies for openings	Limit fire to one fire risk area by providing physical separation	The effectiveness of the barriers, penetrations seals, and other fire rated assemblies is assured by rating these features to be consistent with the rating of the associated barrier. NFPA 80; NFPA 220; NFPA 801; DOE STD 1066-97; DOE O 420.1 provide requirements for the design and installation of these fire assemblies. The effectiveness of the fire barriers, penetrations, and seals is enhanced by the fact that they are passive features of the facility design

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
			The effectiveness of the ability of the operators to place the facility in a safe state is assured by proving physical features or remote operation capability that will allow the operators to place the facility in a safe state for any design basis fire. The principles of safe state capability are found in DOE STD 1066-97, DOE O 420.1 and NFPA 801. Design considerations include NFPA 220 (compartmentation and fire barrier construction); NFPA 12, NFPA 13; NFPA 2001 (automatic suppression systems); NFPA 72 (Fire detection and alarm); and NFPA 92A (Smoke barrier and smoke control)
	Confinement; emergency venting; detection; suppression	Prevent release of radiological and hazardous materials	Fire detection and suppression as covered earlier in this table serve to reduce the challenge to the confinement barriers. Other design features of confinement are provided in Section 2.1, “Shielding and Confinement” and earlier in this table

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
Defense-in-Depth			Separate and limit use of flammable and combustible liquids and gases Limit spread of fire by preventing, controlling and minimizing use of flammable liquid and gases Limit ignition sources Prevent ignition of released combustible gases Provide redundancies, physical separation, remote operation capability, automatic suppression, fire barriers, smoke control Provide safe state capability
Loss of water tank	Second source of water supply	Backup supply of firewater. The importance of a back up supply of water for critical facilities is accepted as a basic tenet of fire protection. Note; the raw water system is also available as an additional source of water. Loss of the raw water system is not an immediate concern as this source is a second backup to the two 100% capacity fire supply tank	Assurance that the backup supply will be adequate and functional is provided by design considerations such as proper sources of water and how such sources are integrated into the facility design as discussed in NFPA 22; DOE STD 1066-97; and DOE O 420.1. The inventory of the backup water source in monitored

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
Loss of fire pump	Pump	Ensure adequate pressure in fire water system	Two 100% capacity pumps Backup for loss of power or other cause of pump failure. Diversity in the fire water pumping system is further provided by use of electric and diesel driven fire pumps. Note: loss of supply from the main fuel oil system does not cause an immediate concern as the diesel driven fire pump has its own day tank The effectiveness of the back up pump is assured by its ability to provide full-capacity pumping capability with the additional feature that it will function upon loss of primary power source. Loss of facility power is addressed by using two independent means of providing pump drivers – electric motor and diesel motor drivers. Effectiveness of the backup pumping capability is assured by implementation of NFPA 20 which provides proper fire pump installation criteria and implementation of the concepts of fire water system redundancies is found in DOE STD 1066-97; DOE O 420.1 and NFPA 801. The back up pump and the primary pump are routinely tested. The electrical power for the electric-driven fire pump is diesel-backed; automatic loading is preferred.

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
	Electric power (support system)	Provide power to the main fire pump	Electric power to the lead fire pump is ITS (See Section 2.3, "Electrical Power")
Break in distribution piping	Looped main with isolation valves spaced around the loop	Backup for possible main failure due to corrosion, physical impact, over pressure, etc.	To provide an adequate supply of firewater for failure in the fire water main. The effectiveness of the looped main system is provided by its design and installation per NFPA 24 which contains other design features as well, such as pipe material, proper design of underground piping, corrosion protection etc.; The concepts of fire water system redundancies found in NFPA 801; DOE STD 1066-97; DOE O 420.1 are also implemented. The use of a looped fire main is a passive feature of the facility design. The isolation valves are manually operated. This design provides a conservative margin that provide flexibility of operations should a single point of failure occur.

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
Failure of automatic suppression	Manual hose stations; fire extinguishers; standpipes; fire hydrants	Provide backup to automatic suppression systems	The effectiveness of the backup fire suppression capability is provided by its ability to suppress design basis fires upon failure of the automatic suppression system. Design, installation, and testing of the manual hose stations; fire extinguishers; standpipes; fire hydrants to NFPA 13, NFPA 14, NFPA 24; NFPA 72 (monitoring valve positions with tamper switches) UBC; NFPA 291; DOE STD 1066-97; DOE O 420.1 provide assurance these fire protection features function to provide backup in case of failure of the automatic suppression system. The manual hose stations and their associated piping are passive features of the facility design. Of course the fire pumps are active components but diverse pumps are provided as discussed above.

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
Failure of fire detection and alarm system	Backup power; monitoring operation of circuits, initiating devices, signaling devices, wiring, power, ground and positive wiring faults, central station alarm	Provide reliability to fire alarm system	The effectiveness of the fire detection features is assured by its ability to detect and alarm failures allowing for corrective maintenance and to accommodate loss of primary power supply. Continuous testing and backup capability serve to identify failures of the detection and alarm system. NFPA 72 requires back up power through the requirement for a battery back up. The fire detection and alarm system includes, within the panel, an uninterruptible (battery-backed) power supply. This supply will power the system for 24 hours without external power.
Water damage	Drainage systems	Limit spread of radioactive or hazardous materials contaminated water to adjacent areas to minimize or prevent damage to equipment	The effectiveness of the drainage system is provided by its capability to remove excessive water while also maintaining control such that the removal of the water does not result in the contamination of other areas. Design considerations to meet these concerns are found in DOE STD 1066-97, DOE O 420.1, and NFPA 801. Additional practical guidance is found in NFPA 30. The drainage system is a passive feature of the facility design.

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
Inadvertent operation of the fire protection system. causing equipment damage	Water barriers/spray shields.	Prevent water damage to safe state equipment.	The effectiveness of the water barriers and spray shields is provided by their ability to protect instrumentation control cabinets from the possible flow of water from an activated sprinkler head. The water barriers and spray shields are passive feature of the facility design.
	Gaseous fire suppression.	Prevent water damage to safe state equipment.	The effectiveness of the gaseous fire suppression is provided by its ability to extinguish fire without causing excessive equipment damage, in particular to equipment not involved in the fire. Because new Halon 1301 automatic suppression systems are no longer installed, NFPA 2001 provides design criteria appropriate for alternative gaseous fire suppression agents such as FM 200.

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
	Pre-action sprinkler systems.	Prevent fire-induced spurious actuation of plant features.	The effectiveness of the pre-action sprinkler system is provided by its ability to extinguish fire without causing excessive equipment damage, in particular to equipment not involved in the fire. In areas where water based fire suppression is desired or indicated, but concern over false trips must be addressed, a pre-action sprinkler system may be installed in accordance with NFPA 14. Such systems require both activation of a fire detection and alarm system as well as fusing of a sprinkler head to allow water to be discharged. These two actions serve to reduce the risk of spurious actuation of the fire suppression system.
			Defense in Depth Assure one train is free of water damage. Separate redundant or safe state equipment. The effectiveness of the train separation and isolation is assured by the ability, that in case of a design basis fire, the second train (when provided) is free of fire damage as required. In most cases provision for physical separation are passive features of the facility design.

Table 2.9-1. Fire Protection

Fault	Important to Safety SSCs	Safety Function	Design Safety Feature
Inadvertent operation of the fire protection system causing inadvertent criticality	Foam/Gas Supression system	Prevent criticality if deemed credible It is currently expected that by control of the feed material, criticality will not be credible (Reference: BNFL *Inc. Work Plan for Criticality Safety Assessment During TWRS-P Part B.*)	The effectiveness of the fire suppression system in facility areas where criticality may be a concern is its ability to provide for required fire suppression capability while eliminating the potential for criticality. The design criteria for proper installation of alternative suppression systems are found in NFPA 11 (Foam-water); NFPA 12 (CO_2); NFPA 2001 (Alternatives to Halon) when such systems are selected to meet this objective